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Condenser Temperature Relief

California Building Energy Efficiency Standards
Revisions for July 2003 Adoption

November 5, 2001

Description

Condenser temperature relief consists of a control sequence to reduce the cooling tower temperature during periods of low-loads and/or low wetbulbs. This practice can achieve significant energy savings if properly applied; but can actually use more energy if improperly applied.

Operating a cooling tower at a fixed, low setpoint wastes energy during times the load and/or wetbulb is such that the tower can never achieve the setpoint. For example, if the tower setpoint is 65°F, but the wetbulb is 70°F, then it will be impossible to achieve the setpoint, even when the tower load is zero. Attempting to do so wastes tower fan energy.

It is possible to monitor the wetbulb temperature and reset the tower temperature accordingly, but wetbulb sensors are notoriously inaccurate.

For towers having VSDs, it is preferable to reset the tower fan speed directly as a function of the chiller loading; for example:

%Load	%Speed
100	100
40	50

Maximum/minimum temperature limits should be superimposed on this reset to ensure the temperature remains within operational bounds.

Towers with two-speed fans (100%/66%) can achieve savings similar to VSDs. For these towers, it is best to normally run the tower on low-speed, without cycling, unless loads exceed an upper boundary (80-90%), or the temperature exceeds the maximum/minimum boundaries (80°F/65°F).

The Standards should require towers with either two-speed or variable-speed fans (no single-speed), and intelligent condenser temperature relief.

Benefits

A cooling tower typically consumes 10%-20% of the energy of the chillers it serves. Intelligent condenser temperature relief can achieve system savings (chiller plus tower) of 20% or more, compared to controlling the tower to the design temperature.

Time dependent valuation would reduce the benefits of this measure, as the energy savings will accrue principally in the non-peak hours. However, since engineers normally apply a safety factor to their load calculations, savings during on-peak periods are also expected. In fact, this technology allows reasonably oversized towers to operate more efficiently than equipment sized to exactly meet the load.

Environmental Impact

VSDs can create harmonic distortion on power lines, which can affect sensitive electronic equipment and can reduce the power factor of a building. These effects are commonly mitigated using filters.

There are no other significant environmental impacts in buildings.

The manufacture of VSDs shares the same environmental considerations as the electronic industry in general.

Type of Change

Prescriptive Requirement	The change would add or modify a prescriptive requirement. Prescriptive requirements must be met for prescriptive compliance and define the Standards baseline building in performance calculations, but are not mandatory when the performance approach is used.

The proposed change expands the existing scope of the standards. Currently, the Standards regulate cooling tower efficiency tower fan unloading mechanisms; the proposed change would specify the control sequence to be used in operating the tower.

This change would affect all documents: Standards, ACM, manuals, and compliance forms.

Measure Availability and Cost

Variable-speed or two-speed fans are commonly used in cooling towers, and are already required in the Standards. As DDC systems are also standard in buildings having chiller plants, the additional cost consists of the additional points and programming, if any, in the DDC system. This cost would typically be under $1,000.

For life cycle cost analysis, the baseline conditions would be current Standards.

Useful Life, Persistence and Maintenance

Energy savings will be consistent over the life of the system. Some degradation may occur in poorly maintained systems, but this degradation would occur anyway.

Performance Verification

The condenser-relief control sequence would need to be referenced in the bid documents, and confirmed in the building commissioning.

Cost Effectiveness

The payback varies between 2 and 5 years, depending on the load pattern of the facility and the system design.

Analysis Tools

Various condenser relief control sequences, including that proposed here, are available in DOE-2.2, and to a lesser extent in DOE-2.1E.

Relationship to Other Measures

Optimal VSD centrifugal chiller operation is dependent on this measure. No other measures are impacted by this change. Note that this proposal may be similar to, or a subset of, a proposal by PG&E, and these proposals should be coordinated.

Bibliography and Other Research

1. Conversations with Dave Holm, ValAir Equipment Company, Sacramento (916) 387-3000
2. Studies performed using DOE-2.2 VSD chiller algorithms, currently in development.